

U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

GROUND GUST CONDITIONS

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Initiated by: ANM-110

AC No. 25.415-1
Change:

1. **PURPOSE.** This advisory circular (AC) sets forth acceptable methods of compliance with the provisions of part 25 of the Federal Aviation Regulations (FAR) dealing with the certification requirements for ground conditions. Guidance information is provided for showing compliance with § 25.415 of the FAR, relating to structural design of the control surfaces and systems while taxiing with control locks engaged and disengaged and when parked with control locks engaged. Other methods of compliance with the requirements may be acceptable.

2. **RELATED FAR SECTIONS.** The contents of this AC are considered by the Federal Aviation Administration (FAA) in determining compliance with § 25.415 of the FAR.

3. **BACKGROUND.**

a. The requirement to consider the effects of ground gusts has been applied to transport airplane since 1950. The purpose of the requirement was to protect the flight control system from excessive peak ground wind loads while the airplane is parked or while taxiing downwind. For developing the original regulation, the control surface load distribution was considered to be triangular with the peak at the trailing edge representing reversed flow over the control surface. This assumption, along with assumptions about the wind approach angle and typical control surface geometries were developed into a table of hinge moment factors and set forth in the regulation. These hinge moment factors have been carried forward to the existing table in section § 25.415. The maximum design wind speed was originally set at 88 feet per second (52 knots) under the presumption that higher speeds were predictable storm conditions and the aircraft owner could take additional precautions beyond engaging the standard gust locks.

b. Amendment 25-91 incorporated a new condition into the FAR for jacking and tie down loads which was similar to the existing Joint Aviation Requirement 25.519. Those conditions required consideration of the airplane in a moored or jacked condition in wind speeds up to 65 knots. In order to be consistent in the treatment of ground winds, § 25.415, concerning ground gust conditions on control surfaces, was increased to 65 knots at the same time.

c. There have been several incidents and accidents caused by hidden damage that had previously occurred in ground gust conditions. Although many of these events were for airplanes that had used the lower wind speeds from the earlier rules, analysis indicates that the most significant contributor to the damage was the dynamic load effect. The dynamic effects were most significant for control system designs in which the gust locks were designed to engage the control system at locations far from the control surface horn. Based on these events, Amendment 25-XX, in addition to clarifying the rule, added additional factors for use in those portions of the system and surface that could be affected by dynamic effects.

d. The flight control system and surface loads prescribed by section 25.415 are limit loads based on a peak wind speed of 65 knots EAS. In operation, the peak wind speed would most often be caused by an incremental fluctuation in velocity imposed on top of a less rapidly changing mean wind speed. Therefore, an appropriate peak wind speed limitation should be reflected in the applicable documents, when there is a potential risk of structural damage.

4. COMPLIANCE.

a. The ground gust requirements take into account the conditions of the airplane parked with controls locked, and taxiing with controls either locked or unlocked. In either of the locked conditions the control surface loads are assumed to be reacted at the control system locks. In the unlocked condition the pilot is assumed to be at the controls and the controls are assumed to be powered, if applicable. In the latter condition, the control surface loads are assumed to be reacted, if necessary, at the cockpit controls by the pilot(s) up to the limits of the maximum pilot forces and torques given in § 25.397(c).

b. Where loads are eventually reacted at the cockpit controls, the loads in those parts of the control system between the control system stops nearest the control surfaces and the cockpit controls need not exceed those that would result from the application of the specified maximum pilot effort effects. However, higher loads can be reacted by the control system stops. Those parts of the control system from the control surfaces to the control system stops nearest the surfaces should be designed to the resultant limit loads regardless of pilot effort limitations. Similarly, pilot effort limitations would not apply to parts of control systems where the loads are not eventually reacted at the cockpit controls, for example an aileron control system where the right hand side aileron loads are reacted by the left hand side aileron, without participation by the pilot(s).

c. In either the taxiing condition (controls locked or unlocked) or the parked condition (controls locked), if the control system flexibility is such that the rate of load application in the ground gust conditions might produce transient stresses appreciably higher than those corresponding to static loads, the effects of this rate of application are required to be considered. Manually powered control systems and control systems where the gust lock is located remotely from the control surface are examples of designs that might fall in this category. In such cases the control system loads are required by § 25.415(e) to be increased by an additional factor over the standard factor of 1.25.
